An evaluation of waterless human waste management systems at North American public remote sites

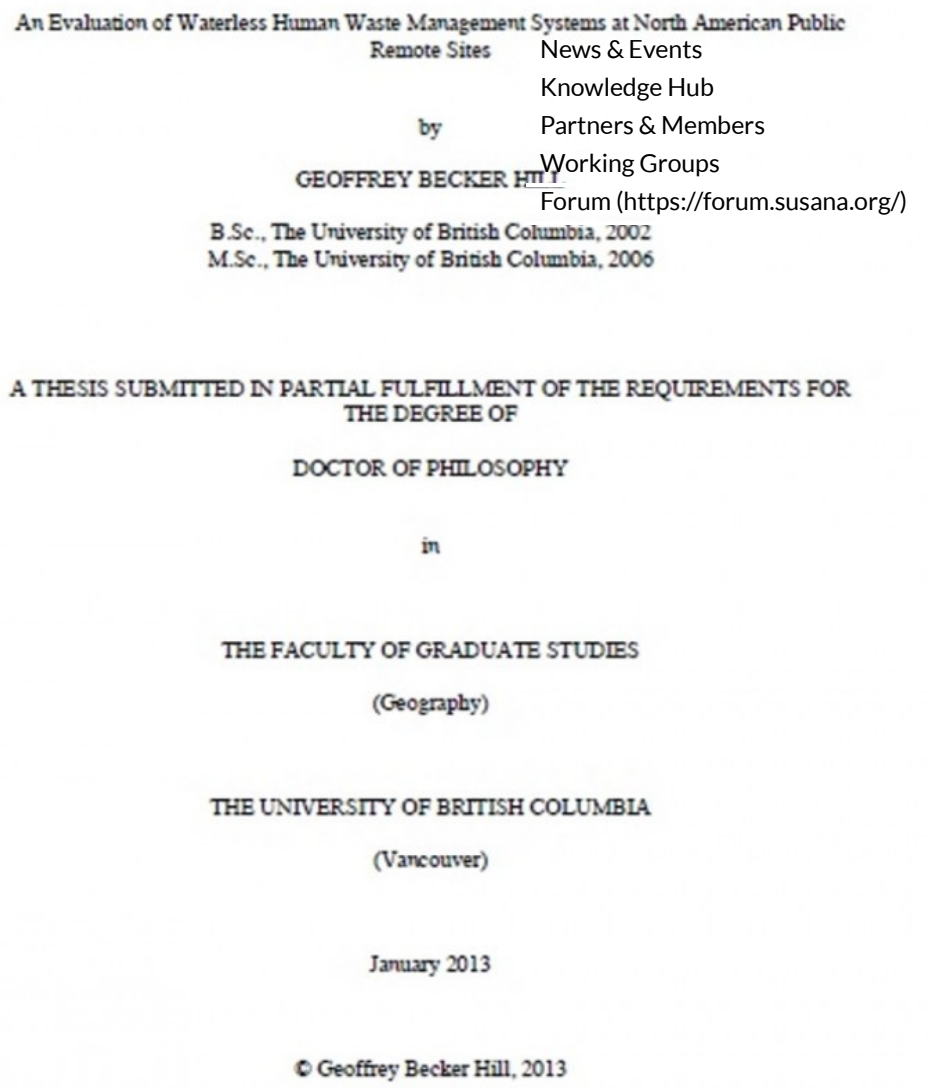
Hill, B. G. (2013)

The absence of sewers and roads at backcountry sites makes the management of human excreta offensive, intensive, and expensive. Proper management is essential in order to prevent deleterious pathogen and nutrient discharge. The dearth of resources, vague certification standards, absence of monitoring, and erroneous popular perception have caused misapplication of systems and mismanagement of end products. Elevated environmental impacts, human health risks, and management costs have resulted. The diversion of urine from urinals and by urine diversion seats significantly reduced the mass of helicopter extracted excrement. However, until a more robust urine diversion system is developed that does not clog, only urine from urinals should be diverted.

Composting toilets failed to produce safe, stable, and mature end-product at all sites surveyed. They should be re-named sawdust toilets, following European nomenclature, to avoid further confusion. Performance was dramatically improved with urine diversion, elimination of bulking agent, and optimization for vermicomposting. Despite improving mineralization and

reduction of volatile solids, operating costs, exposure risk and E. coli, Eisenia fetida earthworms did not reduce Ascaris suum ova concentration or viability. Vermicomposting toilets, unlikely to produce residuals approved for unrestricted discharge, should be designed to minimize waste, costs, hazards, and environmental impacts. This approach is seemingly opposite from sawdust toilets, which at considerable cost, strive against unfavorable biochemistry and thermodynamics to produce 'compost' for onsite disposal despite precautionary federal regulations. Solvita® test paddles, useful in the assessment of end-product, could be used with vermicomposting toilets, to ensure low ammonia is present in feedstock (values 4-5) and to ensure stability (values 7-8) prior to disposal.

Pit toilets, commonly excavated to depths greater than seasonal high ground water, carried the greatest risk of pollution. These were conceptually redesigned to prevent disease transmission and treat nutrients with septic fields. In order to reduce the risks of eutrophication and ammonia toxicity, fields should: be oversized by at least a factor of 10 based on daily urine output; maximize the depth of unsaturated soil with curtain drains where necessary; lie >60m from



An Evaluation of Waterless Human Waste Management Systems at North American Public Remote Sites

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surface water; and where appropriate use natural wetlands such as moist, acidic, productive and phenotypically plastic graminoid meadows.

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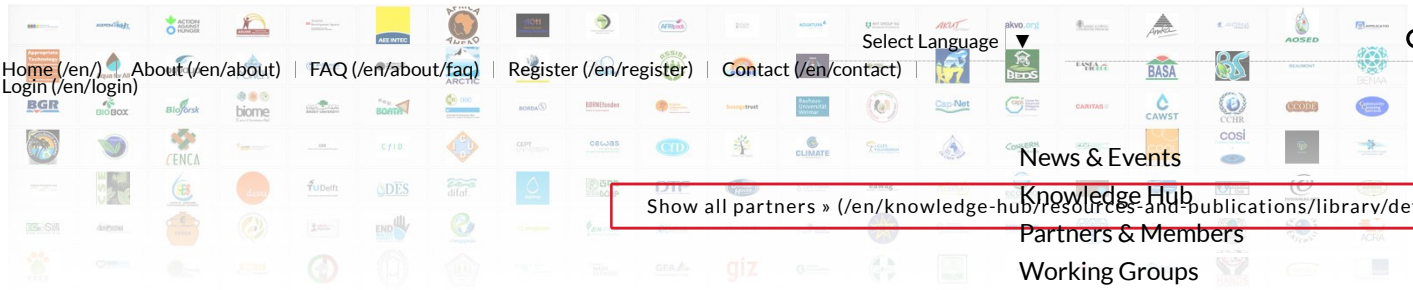

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